

# Challenges and Lessons in High Speed Railway Planning in Denmark

**Harrod, Steven**

*Publication date:*
2015

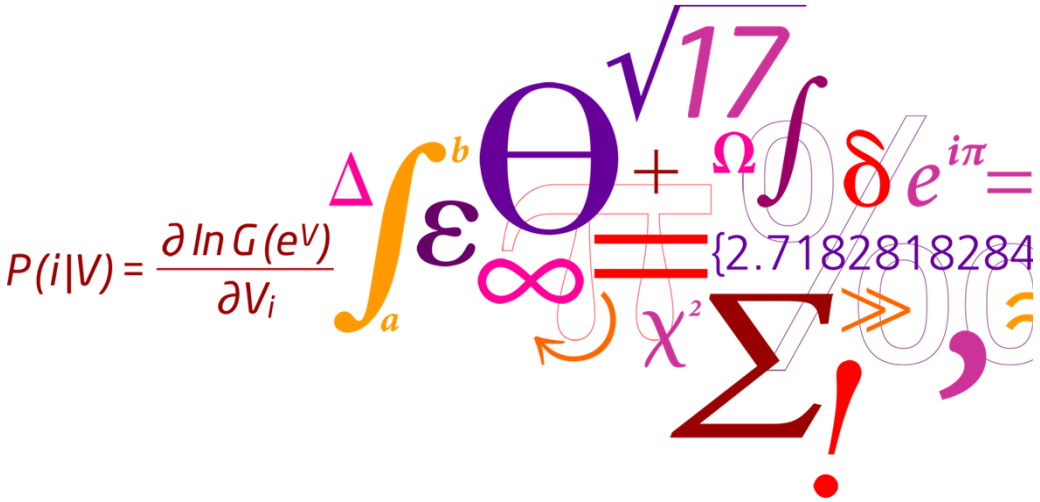
*Document Version*
Peer reviewed version

# Challenges and Lessons in High Speed Railway Planning in Denmark

International Workshop on High-Speed Rail Planning and Operations 2015, Washington DC

Dr. Steven Harrod

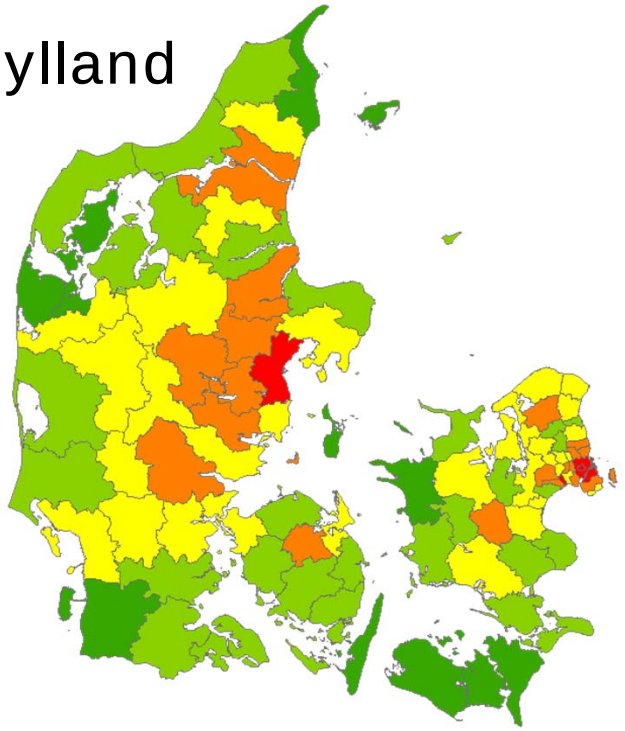
Technical University of Denmark




DTU Transport
Department of Transport

# Danish Strategic Rail Plan

- U.S. $1.5 Billion*
  - Copenhagen-Ringsted
  - Nearly complete, official opening 2018
- U.S. $5 Billion
  - High Speed Alignment for Fyn & Jylland
  - European Signal Standard
  - Electrification
- U.S. $6.9 Billion
  - Femern Bælt-forbindelsen
    Femern Belt Link
  - Copenhagen-Rødby-Hamburg
  - Ferry replacement

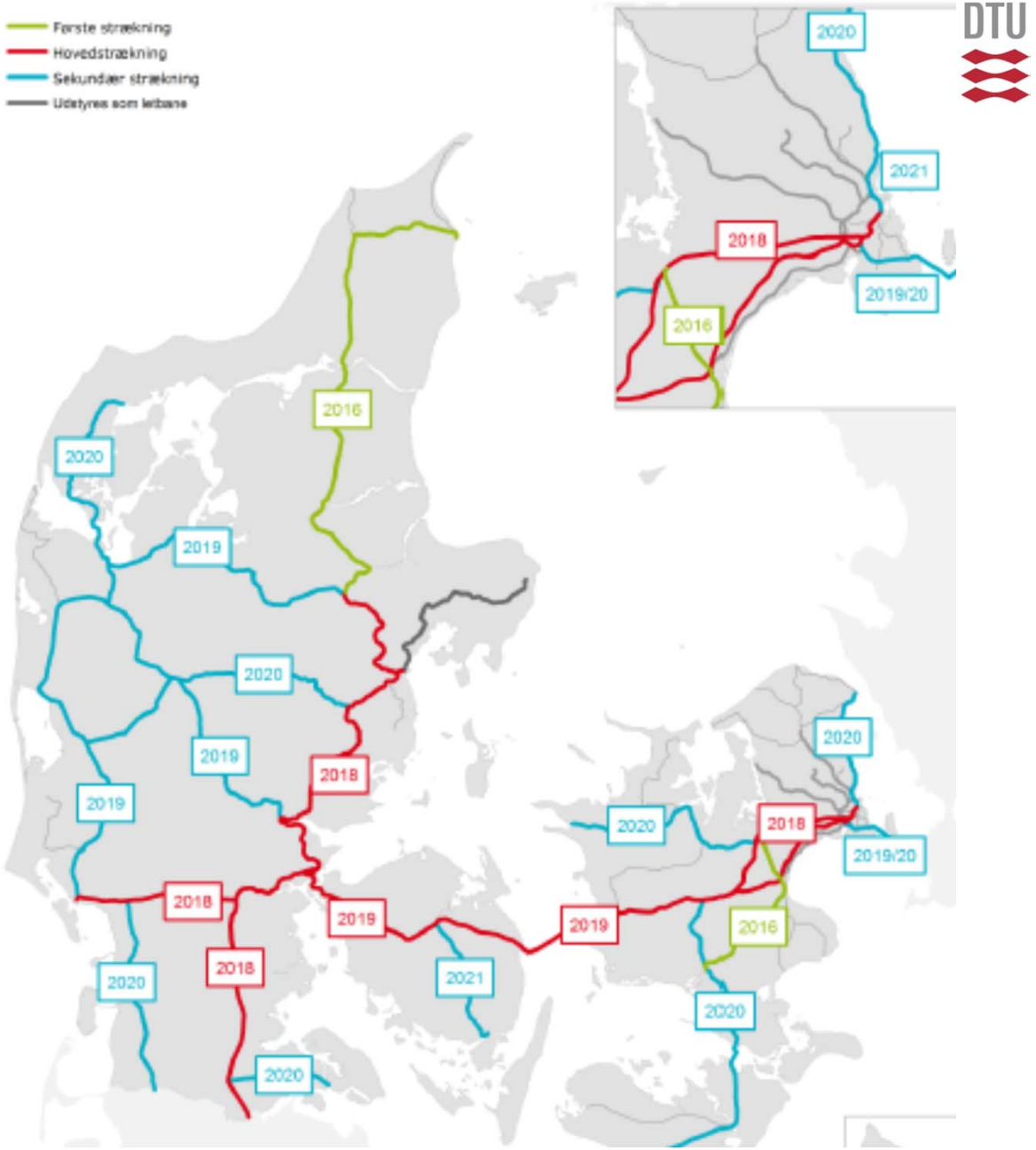




*10.3, 28.5 and 41 Bil. DKK respectively

# New Signals

- ERTMS level 2
- Entirely cab signalled
- No wayside signals
- CBTC for Copenhagen suburban trains



# Electrification

25k v, 50Hz


(15k v, 16.3Hz, Sweden & Germany)

# Femern Bælt Forbindelsen

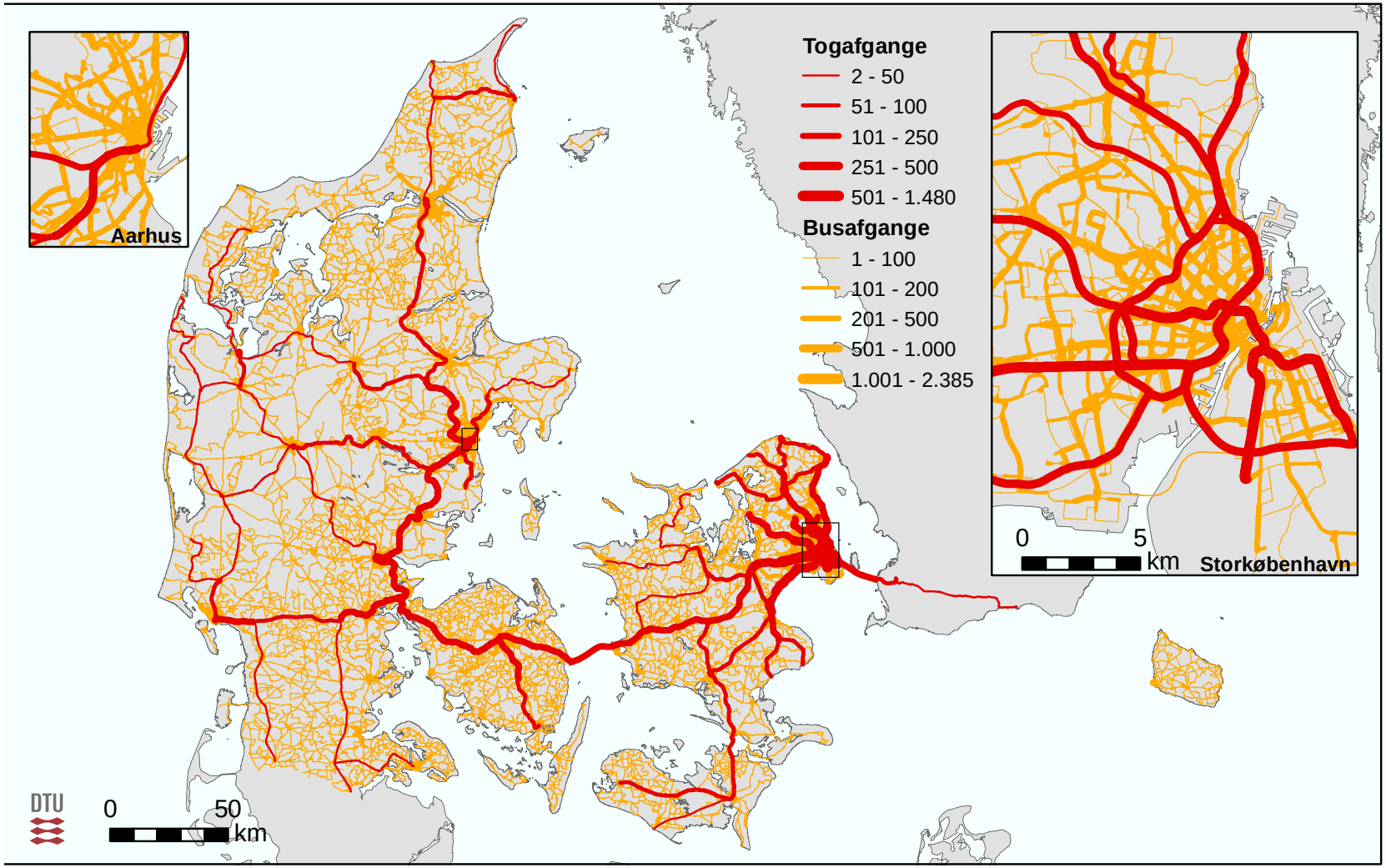
# Strategic High Speed Rail Planning in Denmark

- The Danish Network Today
- Significant High Speed Projects
- Focus on the Whole Journey
- The Planning Process
- Future Forecast

# A Familiar Scenario

- Network Originates from 1850-1880
- Primarily to Connect Port Cities
- Largely Unchanged Since 1940

# Danish Public Transit



# The Hour Model

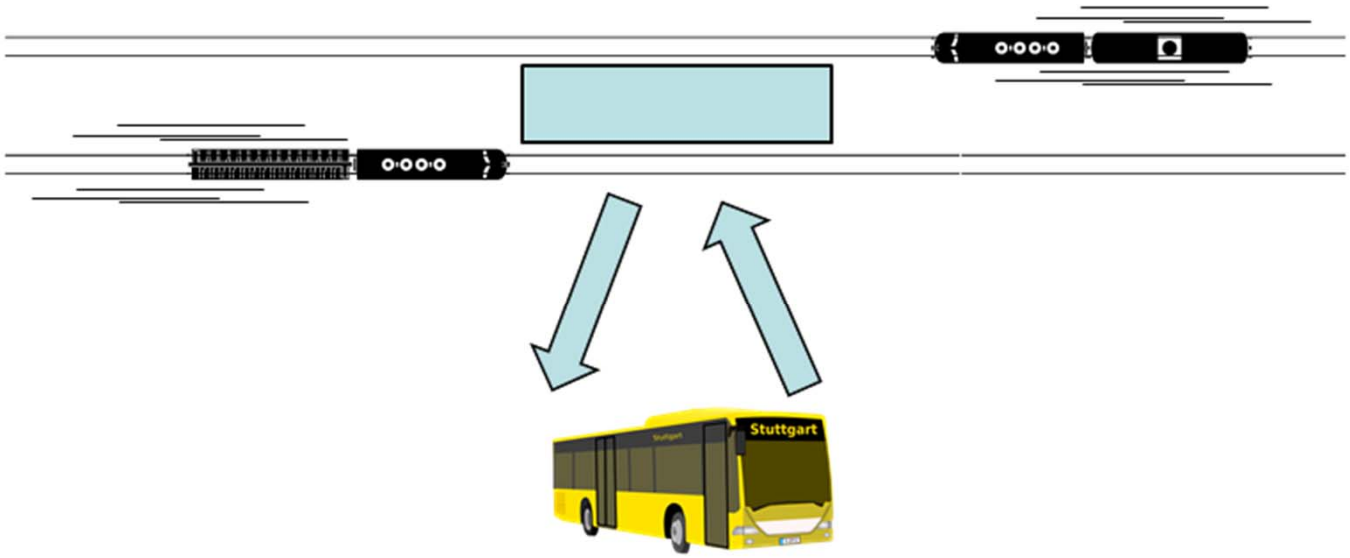
Travel Times Today:
Copenhagen-Odense, 75 min.
Copenhagen-Aarhus, 170 min.
Copenhagen-Aalborg, 259 min.

Percent Reduction Required:
Copenhagen-Odense, 20%
Odense-Aarhus, 37%
Aarhus-Aalborg, 33%

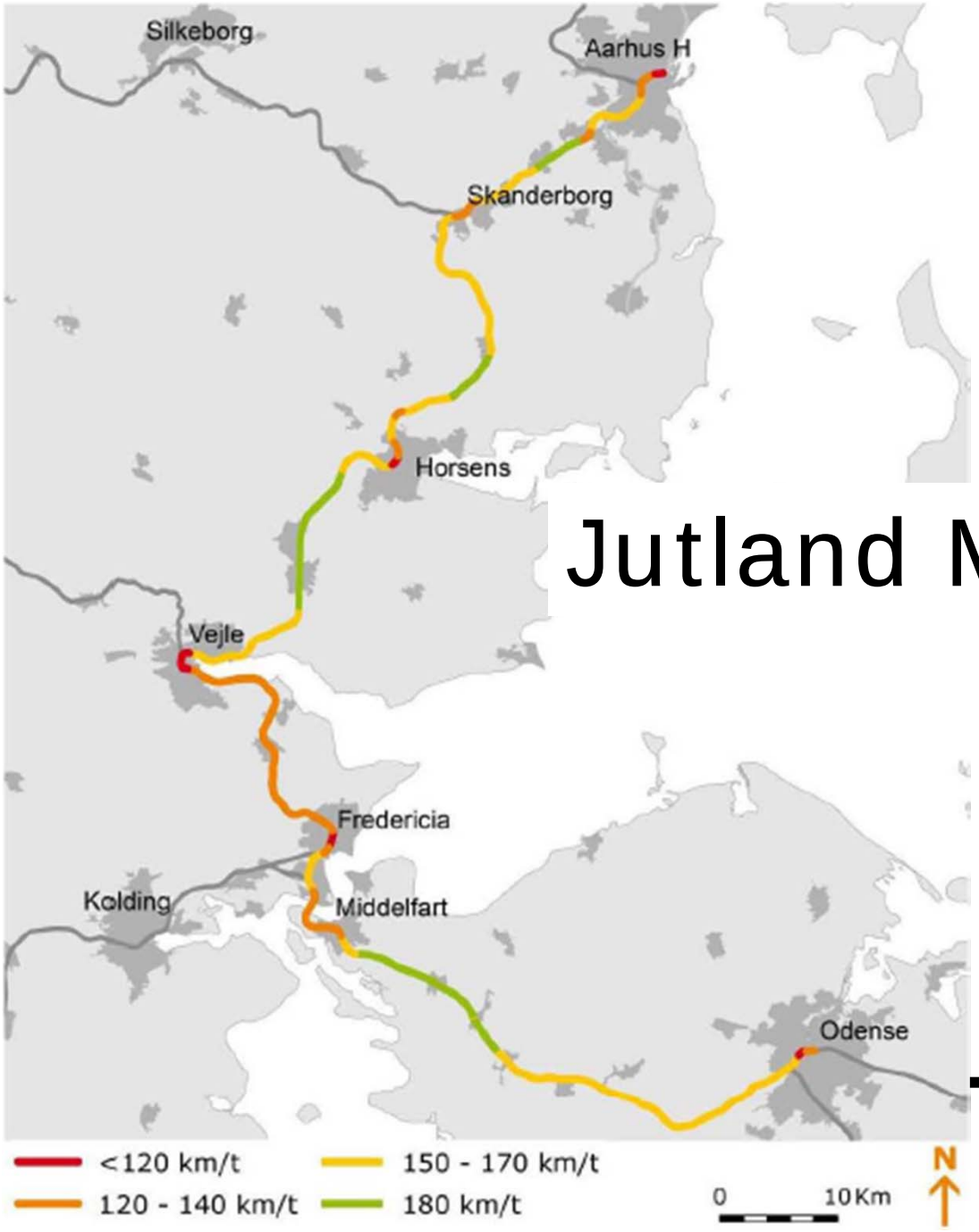
*Not a uniform network upgrade*
*Goal is NOT fastest train route*

# Why One Hour?

- Trains from both directions arrive simultaneously
- Better connections to other services
- Similar to airline hub scheduling
- Less waiting time to/from bus, local rail

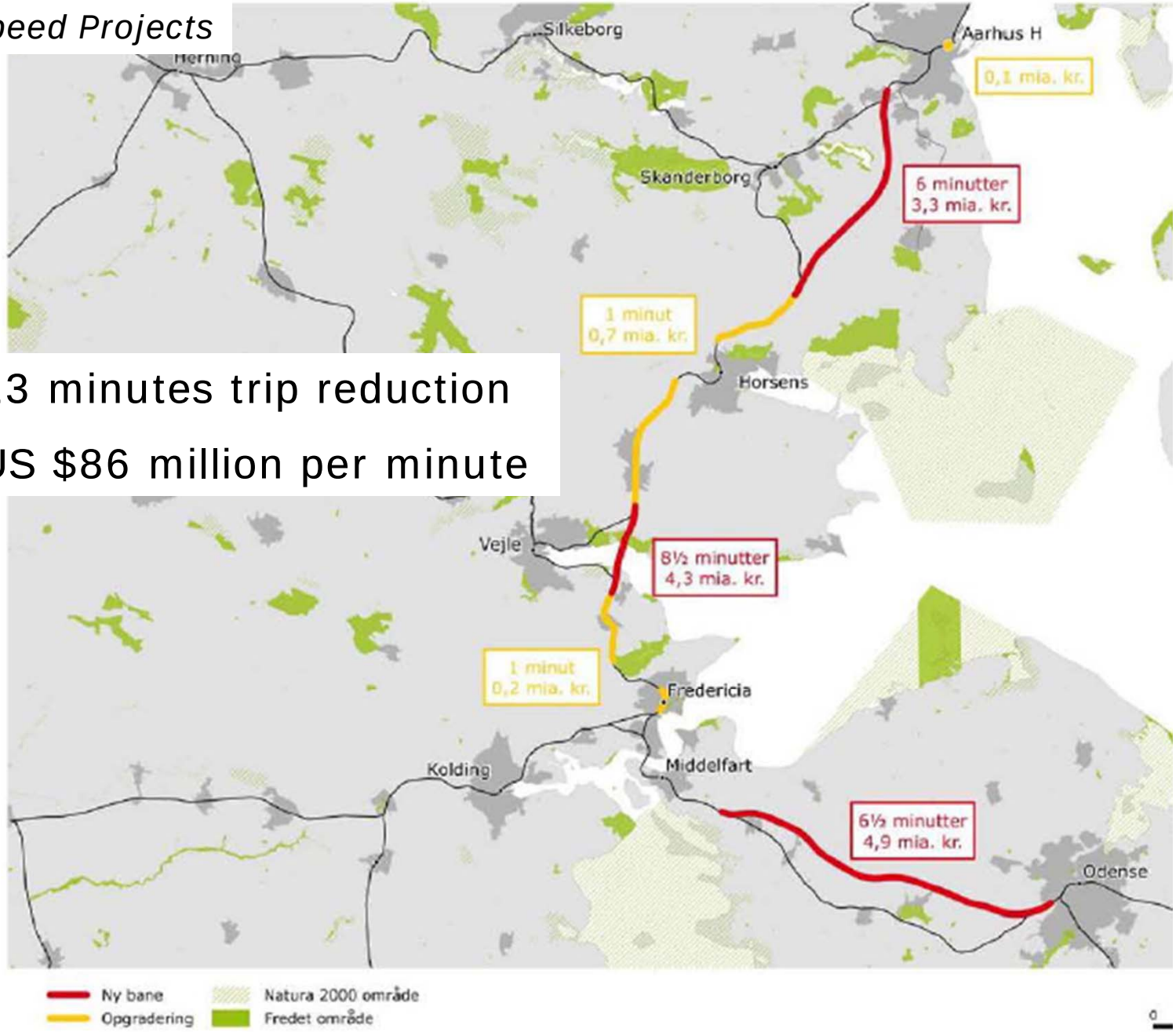


# Jutland Main Today




Copenhagen →

- 23 minutes trip reduction
- US $86 million per minute



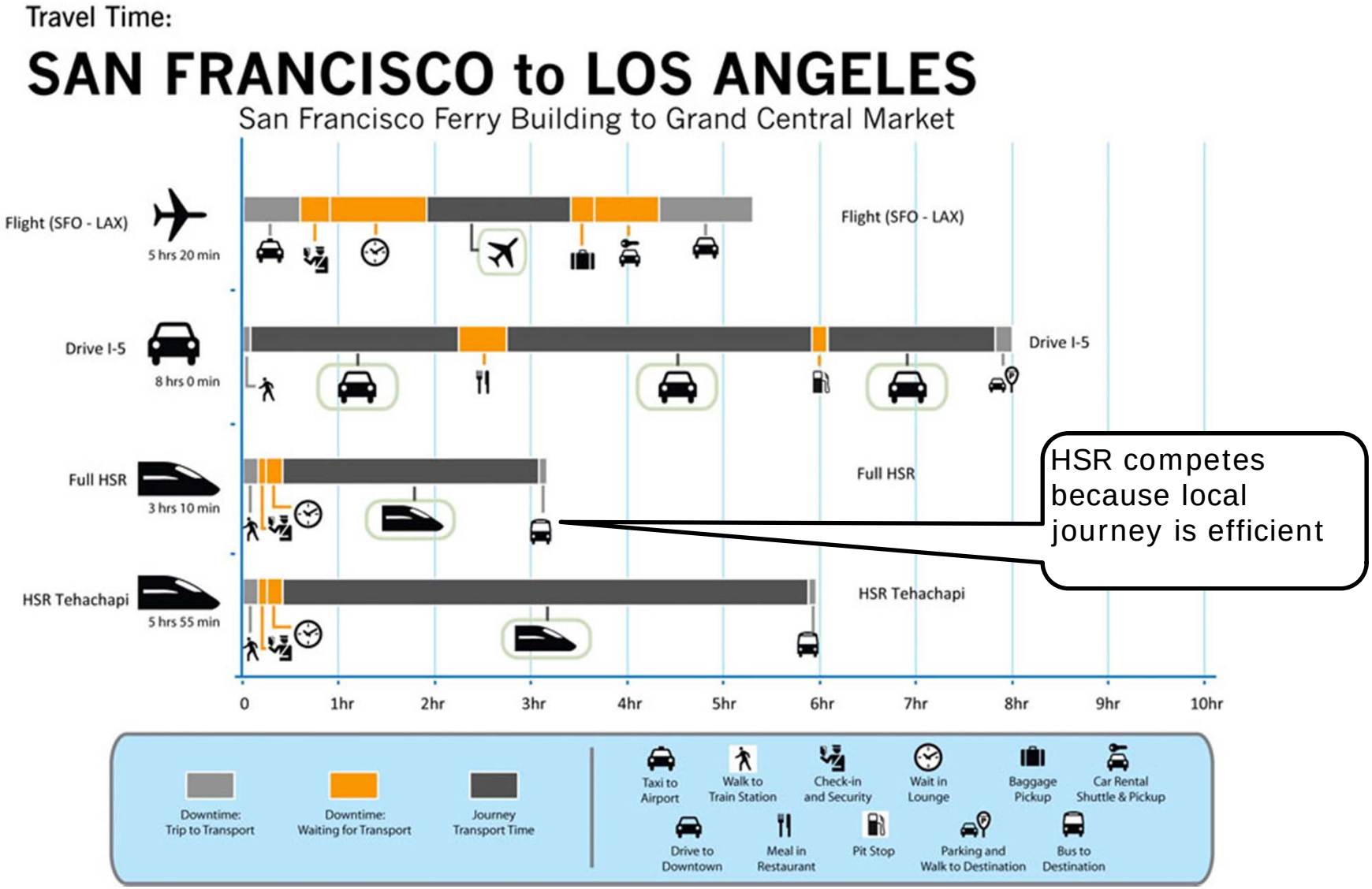
# Incremental Time Savings

| **Travel Time Odense-Aarhus** | **Diesel > IC3 180 kmh** | **IC4 200 kmh** | **Electric > ET 200 hmh** | **ICE 250 kmh** | **Velaro 300 kmh** |
|---|---|---|---|---|---|
| Fastest Scheduled 2015 | 93 min | | | | |
| Reduced timetable slack, 2016 | 87 min | | | | |
| “” and non-stop trip | 78 min | 78 min | 77 min | 77 min | 77 min |
| “”, “”, and high speed network | 61 min | 58 min | 57 min | 55 min | 55 min |
| | | | | | |

*IC3>>ICE; 78-55=23

# The Last Kilometer

- Often the Weak Link
- Coordination and Integration
- Large Scale Schedule Optimization
- Information for Riders
- Reliability and Robustness
  - Strong punctuality
  - Tools for response to failures
- Long Term: Grow Customers Near the System

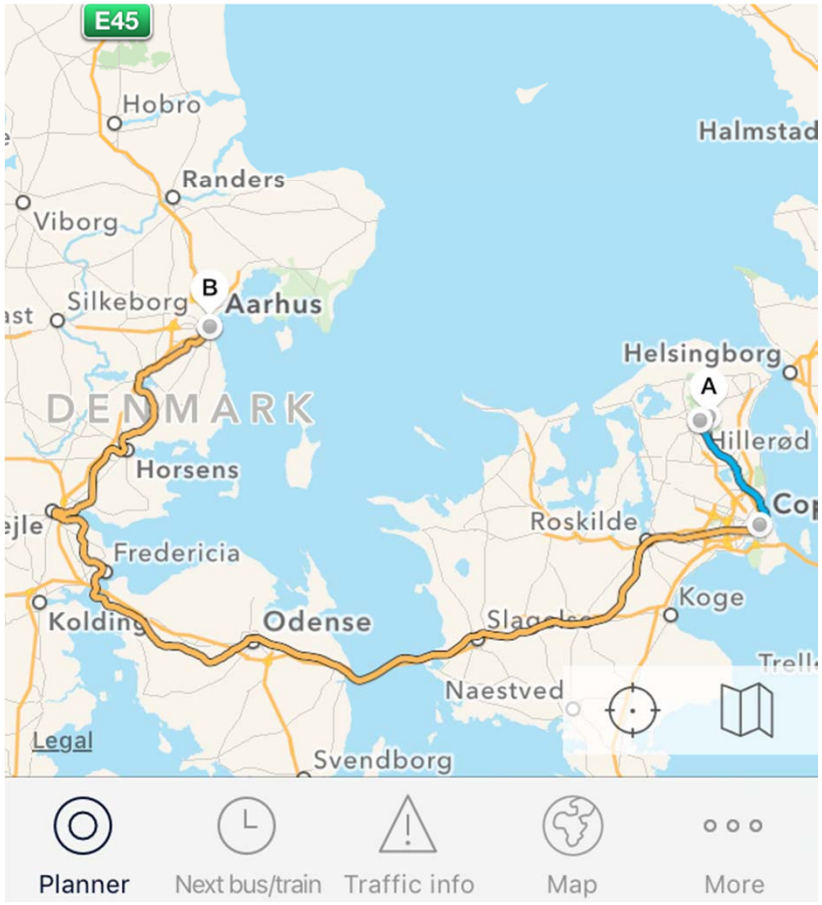





http://urbanlifesigns.blogspot.dk/2012/04/high-speed-rail-tango-part-2.html

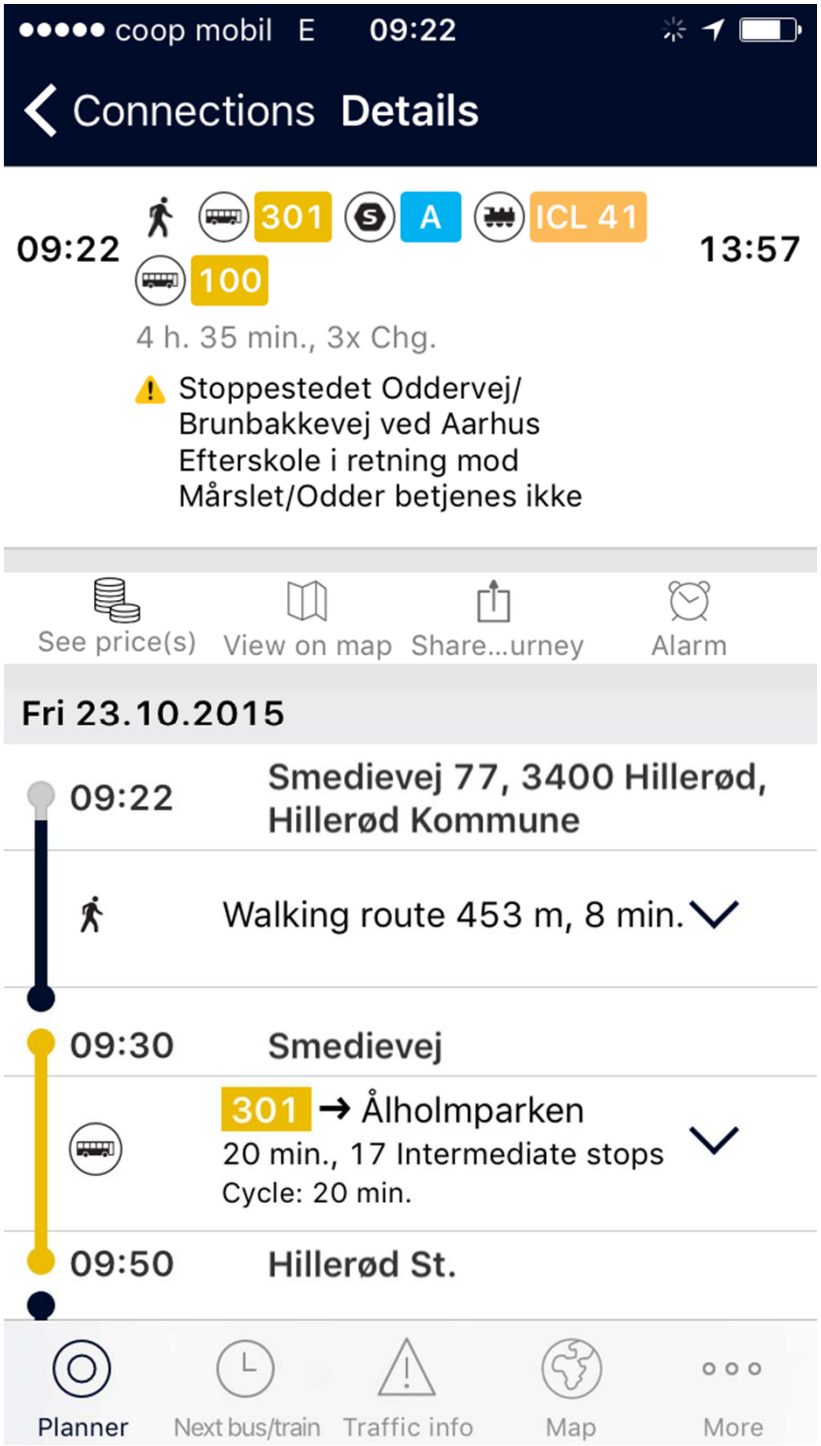
# Seamless Journey From Origin to Destination

- 38% of this journey time is local travel
  - 170 min. intercity train
  - 105 min. transit connection
- HSR will *increase* this ratio
- Customer service focus shifts to local connections

# Integration, Information

- Three Modes
  - Bus
  - Suburban
  - Intercity
- Four Providers
  - Movia
  - S-tog
  - DSB
  - Midttrafik
- Updated, Current



# Planning the København System

- The Players
  - DSB
  - Banedanmark
  - Movia
- Rail Sequence
  - DSB service design
  - Timetable agreement with Banedanmark
- Bus Sequence
  - Movia service design
  - Local subsidy agreement
  - Subcontract of bus routes

# DSB Planning Cycle

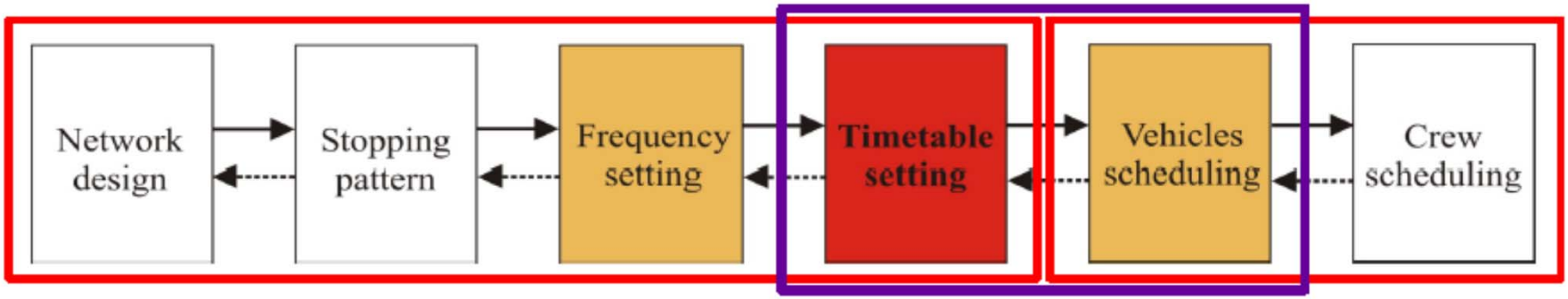

*Steen Larsen, DSB

# Integrated Timetable Challenges

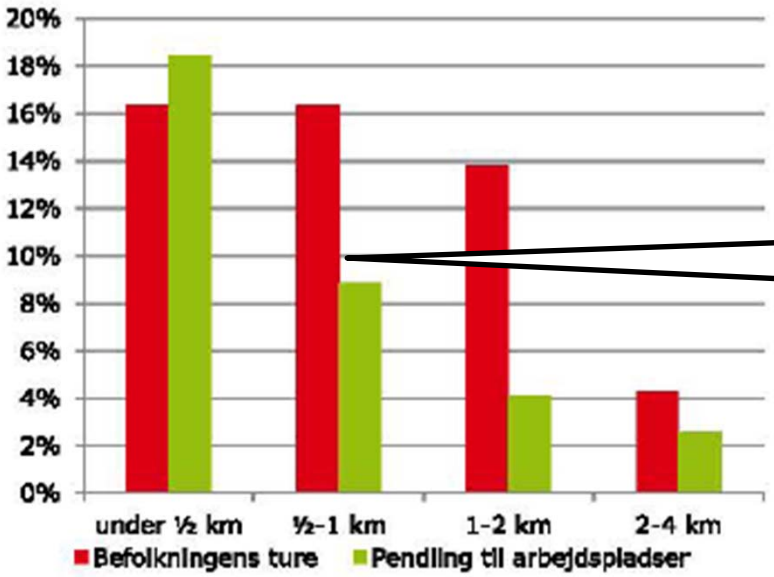
- DSB releases timetables less than six months from start date
- Movia negotiates bus contracts a year in advance
- Buses are also bound by local funding agreements
- Can be difficult to coordinate bus and rail with current mathematical models

# Integrated Planning and Optimisation of Public Transport (IPTOP)

- Five Year Project: 2015-2019
- $2.73 Million
- Danish ”Innovationsfonden”
- Timetable Optimization and Simulation
  - Integrated across modes
  - Integrated across resources (rolling stock, crew)

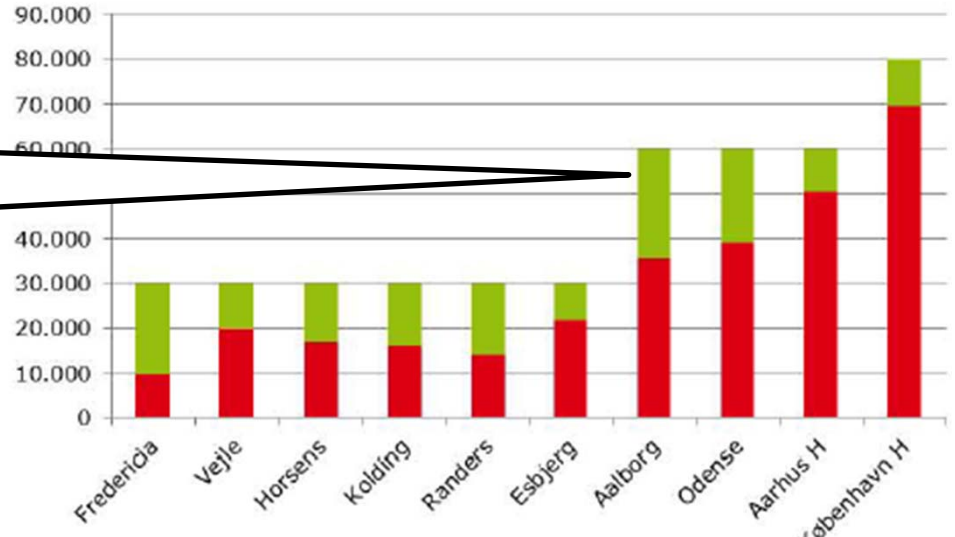


# Land Use Planning




Customers closer to station more likely to use rail

Future land use policy (green) to double development near stations




Population within 1 km of station

# Summary

- High speed rail is not a ground based airplane
- Strategic terminal/station locations and integrated local transit necessary
- Service design must be for a complete journey
- Long term, whole network planning saves money
- The high speed train is only part of the project

# Thank You